9. The method of claim 8 wherein said first reactive gas comprises silane.

10. The method of claim 7 wherein said first reactive gas is activated by an optical energy.

REMARKS

The rejection of claims 1-6 under 35 U.S.C. § 102 and 103 has been obviated by amending these claims so that they more clearly distinguish the invention from the prior art of record. However, before the specific language used in each of the amended claims is discussed, a brief recap of the principal purposes and advantages of the method of the invention will be made so that the language used in the amendment may be more fully appreciated.

Generally speaking, the invention is a method for forming a film over a substrate which utilizes tetra-ethyl-oxy-silane (hereinafter referred to as TEOS) as the reactive gas. In the method of the invention, the step of utilizing TEOS as a reactive gas in a reactive chamber is combined with either (1) inputting optical energy from light emitting by a mercury lamp to photo-initiate the deposition of a silicone-containing compound on the substrate, or (2) the step of applying electric energy into the TEOS reactive gas in order to convert the reactive gas to a plasma, or (3) the step of depositing a first layer on a substrate by means of a reactive gas which comprises a carbon free material. As will be discussed hereinafter in more detail, in all variations of the claimed invention, the use of Teos advantageously provides a uniform film over a substrate even when the surface of the substrate is uneven. This principal advantage is pointed out in detail on page 8,

lines 1-8 of the specification in the following language:

> "The use of TEOS is advantageous particularly for forming a film on an uneven surface, specifically, it is possible to form a substantially even or uniform film, even on a side surface of or on a lower surface between the steps shown in Fig. 6(a) by reference numeral 51. It is presumed that this is because TEOS is in a liquid state at room temperature and has a relatively large viscosity even when it is gasified."

Of course, the ability to form a film of uniform thickness enhances the overall quality of the finished substrates. In addition to improved quality, other purposes of the invention include the more rapid and less expensive production of films over substrates. The use of TEOS helps achieve both of these purposes, as the use of TEOS creates the desired films faster and less expensively than the use of other reactive gases.

Claim 1 has been amended in order to emphasize one of the features responsible for the high productivity and quality associated with the method of the invention. Specifically, claim 1 recites a method for forming a film that comprises the steps of placing a substrate in a reaction chamber, introducing a reactive gas "comprising tetra-ethyl-oxy-silane into said reaction chamber; ..." inputting an optical energy for activating the reactive gas and, therefore, depositing a silicone-containing compound on the substrate "wherein said optical energy is light emitted by a mercury lamp..."

None of the references of record either discloses or suggests the method recited in amended claim 1. While the primary reference of record, the Horioka '020 Japanese patent, does disclose the use of TEOS to form a thin film over a substrate, this reference teaches

activating the TEOS by means of a Xe-Cl laser. By contrast, amended claim 1 specifically recites activating the reactive gas by means of "light emitted by a mercury lamp..." There are two advantages associated with the use of a mercury lamp over an Xe-Cl laser. First, productivity is improved since larger areas of substrates can be processed all at once by means of a bank of mercury lamps. Such highly productive configurations are described in detail in the specification, and are illustrated in Figs. 3 and 4. Secondly, the wavelengths of light emitted by mercury lamps such as that recited in the claim are generally on the order of 254 nm and 185 nm. By contrast, the wavelength of light emitted by an Xe-Cl laser is on the order of 308 nm. Since it is well known in the art that TEOS reactive gas is more readily decomposed by light having wavelengths on the order of 254 nm and 185 nm, the use of a mercury lamp again results in more efficient production of the desired thin film than the use of an Xe-Cl excimer laser. For all these reasons, amended claim 1 is clearly patentable over the Horioka '020 patent.

As none of the other references of record either discloses or suggests the combination of method steps of utilizing TEOS as a reactive gas and depositing a silicone-containing compound on the substrate by inputting optical energy in the form of "light emitted by a mercury lamp...", amended claim 1 is clearly patentable over all of the other references of record.

Amended claim 2 is likewise patentable over the Horioka et al patent, albeit for different reasons. Specifically, amended claim 2 recites a method for forming a film comprising the steps of placing a substrate in a reaction chamber, introducing TEOS gas

into the chamber, and "supplying electric energy into said reactive gas in order to convert said reactive gas to a plasma;..." and thereby depositing a silicone-containing compound onto the substrate. Thus, amended claim 2 basically recites a plasma-type chemical vapor deposition method wherein the reactive gas is TEOS. As has been previously pointed out, the use of TEOS as a reactive gas is advantageous in view of the generally high rate of film creation which can be obtained on a substrate. Since a plasma deposition technique is generally faster than a photo deposition technique, the combination of a plasma deposition technique wherein TEOS is used as the reactive gas is highly advantageous because the combination of these two factors leads to a very high deposition rate and consequently, a very high film production rate. Because the Horioka patent neither discloses nor suggests the use of plasma in combination with TEOS in a chemical vapor deposition method, amended claim 2 is clearly patentable over this reference.

Claim 3 is patentable not only for its dependency upon claims 1 and 2, but further for its recitation that the substrate to be coated with the film "has an uneven surface...", thereby underscoring one of the fundamental advantages of the use of a TEOS reactive gas, i.e., the fact that such gas results in the production of films with highly uniform thicknesses despite an uneven contour on the surface of the substrate being coated.

Claims 4 and 5 are patentable not only for their dependencies upon both amended claims 1 and 2, but for their recitation of other aspects of the inventive method of the invention which, when taken in combination with the method steps in the base claims, define the invention in terms which are even further outside the

prior art of record.

Claim 6 is dependent upon claim 5 which in turn is ultimately depend upon either claims 1 or 2. Accordingly, all the arguments given with respect to the patentability of claims 1, 2 and 5 apply to claim 6 as well.

Finally, new claim 7 is patentable by virtue of its recitation of the steps of introducing a first reactive gas "comprising a carbon free material" into the reaction chamber, and activating this gas in order to deposit "a first layer on said substrate; ..." The basis of this claim is supported in the specification in the last paragraph on page 7, and in the illustration shown in Fig. 6. This particular definition of the method of the invention is highly desirable in cases where the underlying substrate may be negatively influenced by carbon impurities. For example, it is well known that the conductivity of a silicone semiconductor is easily negatively affected by a contamination of carbon atoms. Since TEOS contains carbon, the method recited in claim 7 solves the problem of potential carbon contamination by reciting the formation of a buffer layer between the substrate and the film formed from the TEOS. The buffer layer, corresponding to the "first layer on said substrate" recited in the claim, is formed by a photo-CVD or a plasma-CVD using a carbon-free reactive gas such as silane. Since none of the references of record either discloses or suggests the formation of such a carbon-free buffer layer in combination with the deposition of a second layer of a silicone compound from TEOS, new claim 7 is clearly patentable over not only the Horioka et al reference, but all the other references of record.

The balance of the claims 8, 9 and 10 are each

patentable by reason of their ultimate dependency on claim 7.

Now that all the claims in this case are considered to be patentable the prompt issuance of a Notice of Allowance and Issue Fee Due is hereby earnestly solicited.

Respectfully submitted,

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